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Ecological Analysis of a Tropical Lizard Community

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Initial Proposal

Most studies of lizard communities have been conducted in temperate environments; tropical studies are relatively sparse. The known ecology of tropical lizards almost exclusively pertains to Anolis, as attested by the long-term investigations of Williams (1969, 1972) and the studies of Crews (in press), Rand (1964, 1967), and Schoener (1970a, b). In contrast, very little work has been done on the ecology of other lizard groups in the tropics. Schall (1973) studied the ecological relations of three macroteiid lizards on Aruba Island, Sexton et al. (1964) correlated microdistribution of lizards with structural organization of habitat in Panama, and Hirth (1963) investigated the ecology of lizards associated with a tropical beach. An area where no investigations of reptilian ecology have been conducted is the vast plains of Venezuela known as the Llanos. Research is urgently needed in this type of tropical environment, for it is rapidly undergoing ecological change due to pressures of cattle production and agriculture (Ministerio de Agricultura y Cria, pers. comm.).

The purpose of the proposed investigation is to determine the species composition, relative abundance, habitat associations, niche characteristics, and aspects of breeding biology of lizards in this tropical plains community. Some specific questions to be answered are:

- A. What are the species density and diversity of lizards in this community?
- B. What are the structural and behavioral factors responsible for their microdistribution?
- C. What trophic (energy) levels are represented in this community?
- D. What is the reproductive condition of the lizards within the community?

Description of Study Area and Methods

During June 1974, Dr. Swain conducted preliminary investigations on the community structure of the lizard fauna of the Llanos in central Venezuela. A study site (5,000 m²) was established, specimens were collected and observed, and data on general vegetational structure obtained. Lizards present were members of the families Amphisbaenidae, Gekkonidae, Iguanidae, and Teiidae.

Another study site of similar size and habitat will be established to avoid biasing or chance effect on the data to be gathered. Each site will be divided into quadrats (8 X 8 meters) and assigned a number which can be randomly picked for sampling. •

Methods and Procedures

1. Species Density. Species will be determined by mark-recapture. Individuals will be noosed or trapped and then permanently marked by toe clipping as per Martof (1953). A regression method for mark-recapture estimation of population size with unequal catchability will be used (Marten, 1970): $\hat{U}_+ = bN - bM_+$, where \hat{U}_+ is the estimate of the unmarked population, b is the constant proportion of unequal catchability between samples, N being population size and M_+ the total numbers of marked animals. In addition, the intraspecific class structure of each species will be determined by classifying individuals as immature, subadult or adult as per Andrews (1971). The biomass of each species will also be calculated to give a more accurate index of productivity.

2. Species Diversity. The Shannon and Weaver formula (1963) will be used to calculate lizard species diversity.

$$H' = - \sum_{i=1}^s p_i \log p_i,$$

where p_i is the proportion of the i th species in the community and s is the total number of species.

3. Spatial and Temporal Activity Range. Individuals to be used for behavioral observations will be temporarily marked with Day-Glo paint. Observations of territorial, foraging, and breeding behavior will be made on each species in the community. Time of day, ambient temperature, insolation, microhabitat description, and zones utilized (see vegetational analysis below) will be recorded and mapped.

4. Vegetational Analysis. Where trees and shrubs are present in the Llanos the vertical vegetation composition conveniently breaks up into four zones: grasses and forbs (0 - .5m), shrubs (.5m - 2m), understory trees (2m - 6m), and canopy trees (greater than 6m). To determine vegetational cover, line-intercept (Canfield, 1941) will be utilized.

Where shrubs and trees are dense it will be modified to the crown spread intercept (Phillips, 1959). In areas where shrubs are more widely spaced, a modified belt transect will be used to compensate for the tendency to underestimate with line-intercept.

5. Autecology.

a. Data to be obtained on all specimens trapped:

- (1) snout-vent length
- (2) wet weight
- (3) sex and age determination
- (4) tail absent, regenerated, or intact
- (5) cloacal temperature

b. Data to be obtained on specimens collected outside study sites, but in similar habitat:

- (1) all of the above
- (2) qualitative and quantitative analysis of stomach content
 - (a) item frequency (per stomach)
 - (b) volume displacement
 - (c) item size
 - (d) percent occurrence of item in all specimens
- (3) gonadal size and reproductive state
- (4) visceral fat content

Dr. Swain feels that the proposed investigation will add significantly to our knowledge of reptilian ecology in a tropical environment, serve as a baseline study for future investigations in this area, and provide valuable information concerning a unique tropical ecosystem, the Llanos. Lizards collected and color transparencies of specimens and their habitat will be deposited in the University of Colorado Museum and the "Instituto de Zoología Agrícola de la Facultad de Agronomía de la Universidad Central de Venezuela".

Bibliography

Andrews, R. M. 1971. Structural habitat and time budget of a tropical Anolis lizard. *Ecology*, 52:262-270.

Canfield, R. 1941. Application of the line interception method in sampling range vegetation. *J. For.*, 39:388-394.

Crews, David P. and J. A. Stamps. Seasonal changes in reproduction and social behavior in the lizard Anolis aeneus. *Copeia*, in press.

Evans, L. T. 1951. Field study of the social behavior of the black lizard Ctenosaura pectinata. *Amer. Mus. Nov.*, no. 1493, pp. 1-26.

Hirth, H. F. 1963a. The ecology of two lizards on a tropical beach. *Ecol. Monogr.*, vol. 33, no. 2, pp. 83-112.

Marten, G. G. 1970. A regression method for mark-recapture estimate of population size with unequal catchability. *Ecology*, 51:291-295.

Martof, B. S. 1953. Territoriality in the green frog Rana clamitans. *Ecology*, 34:165-174.

Phillips, E. A. 1959. *Methods of vegetation study*. Holt, Rinehart and Winston, New York.

Rand, A. S. 1967. Ecology and social organization in the lizard Anolis lineatopus. *Proc. U.S.N.M.*, 122:1-79.

Schall, J. J. 1973. Relations among three macroteiid lizards on Aruba Island. *Jour. Herp.*, 7(3):289-295.

Schoener, T. W. 1970a. Nonsynchronous spatial overlap of lizards in patchy habitats. *Ecology*, 51:408-418.

_____. 1970b. Size patterns in West Indian Anolis lizards. II. Correlations with the sizes of particular sympatric species-displacement and convergence. *Amer. Natur.*, 104:155-174.

Sexton, O. J., H. Heatwole and J. Knight. 1964. Correlation of micro distribution of some Panamanian reptiles and amphibians with structural organization of the habitat. *Carib. J. Sci.*, 4(2):261-295.

Shannon, C. E. and Weaver, W. 1963. *The Mathematical Theory of Communication*. Urbana. Univ. of Illinois Press.

Williams, E. E. 1969. The ecology of colonization as seen in the zoogeography of anoline lizards on small islands. *Quarterly Review of Biology*, 44(4):345-389.

_____. 1972. The origin of faunas. Evolution of lizards congeners in a complex island fauna: a trial analysis. *Evolutionary Biology*, 6 (Dobzhansky, Hecht and Steere, editors):47-89.

_____. 1970b. Size patterns in West Indian Anolis lizards. II. Correlations with the sizes of particular sympatric species-displacement and convergence. *Amer. Natur.*, 104:155-174.

PROGRESS REPORT

The proposal presented here is a continuation of the ecological analysis of a tropical lizard community. The first portion of the study was submitted as a proposal and supported by a Van Riper Grant March 1975. Part I is a report on the type of data collected and the progress of the study since May 1975. Part II outlines the field work to be continued from September 1976 through February 1977 and the necessary funds requested.

Part I

Location of study sites: Camatagua, Venezuela. Latitude: 9°45'N.

Longitude: 66°52'W. Elevation: 240m. Life zone: Dry deciduous forest.

Study site #1: grass-shrub, area of 2400 sq. meters.

Study site #2: deciduous forest, area of 2400 sq. meters.

Description of vegetational conditions: The study began during the latter part of May, the end of the dry season. The vegetation was extremely dry, most was dormant. Mid-June was the onset of the rainy season and within a few weeks all the vegetation was green. Following the vegetational change, insect emergence was at its height. According to botanists at the herbarium in Caracas vegetational growth in the Camatagua area was stabilized by the end of July. The most profound changes in the tropics occurs during this period of seasonal transition. Therefore this time was ideal for measuring seasonal effects on this lizard community.

Data Collected: The two study sites were marked off into numbered 10X10 meter grids. Study site A was inhabited predominantly by a teiid lizard, Cnemidophorus lemniscatus. Study site B was inhabited exclusively by an iguanid lizard, Tropidurus torquatus. These two lizards were found sympatric in the area between site A and site B.

A. Daily Field Data Obtained:

1. Temperature and humidity every half-hour, eleven hours per day.

2. Vegetational analysis.

- study site A, line-intercept.
- study site B, quarter method of sampling forest stands.
- determination of species density, diversity, and vertical vegetational structure.
- plants of the area were photographed, collected, identified, and deposited at the herbarium of the University of Colorado Museum.

3. For every lizard caught and released or preserved the following data was obtained.

- body temperature; ambient and substrate temperature where lizard was sighted.
- snout-vent length, tail length, jaw length and width, weight, tail condition.
- activity and posture at time of capture, location and time of day at capture, insulating conditions.
- lizards were permanently marked by toe-clipping; temporarily marked with day-glo enamel.
- three-quarters of these data are in a permanent file at the University of Colorado Computing Center for retrieval and statistical analysis.

4. Behavioral Observations. The data below were collected at half

hour intervals from the time the lizards became active in the morning to their return to sleeping sites in the evening.

Observations were made on both marked and unmarked lizards in the study areas.

- numbers of lizards observed at each time interval.
- activities, ie., basking, foraging, feeding, territorial defense, courtship, copulating, nest building, etc.

- location: specific areas within the numbered grids, type of substrate, distance from ground, etc.
- most activity and posture was recorded on 35mm stills and 16mm movie film.

5. To determine type of food available insects were collected throughout the seasonal change by random sweep-netting within the area.

B. Laboratory Data on Preserved Specimens:

1. Stomach Analysis.

- volume and weight of each stomach and stomach contents.
- percent food type.

2. Reproductive Condition of Testis and Ovaries.

Upon completion of the above analyses the preserved specimens collected will be deposited at the University of Colorado Museum.* Two by two transparencies of animals and their habitats are presently being duplicated for deposition at the Museum. To date two papers generated from the above data will be presented at the CWAS meetings this April in Boulder (see attached preliminary abstracts). * and the " Instituto de Zoología Agrícola de la Facultad de Agronomía de la Universidad Central de Venezuela".

Part II

Tropidurus torquatus is one of the most widely distributed lizards in northern South America. Its distribution encompasses most of Venezuela's life zones (Rand, 1966). In most areas it is sympatric with other insectivorous lizards. The author observed Tropidurus torquatus basking and feeding on the same rocks with Plica plica in dry savanna south of the Orinoco River. One of the purposes of this study is to determine how Tropidurus partitions its various habitats which enables it to co-exist so closely with a variety of lizards.

Cnemidophorus lemniscatus is almost as widely distributed as Tropidurus torquatus (Schall, 1968). It is found along sandy coasts of Venezuela and Columbia, islands of Aruba and Trinidad to the Llanos of central Venezuela (Peters, 1970).

With the exception of the aforementioned papers there are few published works on either of these lizards. Other than anoline lizards there are no definitive ecological studies on any tropical lizard known to this author. For review of the objectives of this study please refer to original proposal submitted March, 1975 (copy enclosed). The same methods and procedures mentioned in Part I of this paper will be employed in the continuation of this study. Data will be gathered at the same study sites, but for a period six months later in the year. No lizard marked in either study area was removed allowing for continuous study months or years later. The research in this dry deciduous forest will be conducted in other life zones. Work will be resumed in areas started in 1974, the Llanos of central Venezuela and the Savannas south of the Orinoco River.

Bibliography

- Peters, J. and R. Donoso-Barros. 1970. Catalogue of the neotropical squamata
Part II. Lizards and Amphisbaenians. Bull. U. S. Natl. Mus., 297:i-vii,
1-293, ill.
- Rand, A. S. and P. Rand. 1966. Aspects of the ecology of the iguanid lizard
Tropidurus torquatus at Belem, Para. Smithsonian Misc. Coll. (151):1-16.
- Schall, J. 1968. Notes on the behavior of the tropical American whiptail
lizard Cnemidophorus lem[n]iscatus. Bull. Phila. Herp. Soc. 16:33-35.

VITA

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Education:

- 1971 B.A. Metropolitan State College, Denver, Colorado
- 1974 M.A. University of Colorado, Boulder, Colorado
- 1977 Ph.D. University of Colorado, Boulder, Colorado

Languages:

Fluent in Spanish.

Professional Experience:

- 1973 Consulting herpetologist for Boulder Sierra Club. Directed herpetological census of Boulder County to be used by the City Planning Board for the Green Belt Program.
- 1975 Member of committee to establish herpetofauna status in Colorado for the Colorado State Fish and Game.
- 1976 Staff member of Denver Museum of Natural History. As the special project coordinator designed and constructed a multi-media learning-demonstration center. The center contained graphic material, color slide programs, and live demonstrations concerned with all aspects of reptilian fauna.

Teaching Experience:

- 1971 Metropolitan State College, Denver, Colorado
Instructor for Practical Field Ecology 480. A summer course involved in the practical methods and procedures of ecological research conducted in the field.
- 1972- University of Colorado, Boulder, Colorado.
1976 General Biology 101-102:
Teaching Assistant - 2 years
Coordinator - 2 years
Lecturer - subjects on physiology and ecology
- Parasitology 302:
Teaching Assistant - 1 semester
- Human Anatomy 219:
Teaching Assistant - 1 semester
Coordinator - 1 semester

Teaching Experience (cont'd):

- 1976 Denver Museum of Natural History, Denver, Colorado. Conducted training programs on reptiles for the volunteer staff of the Education Department.
- 1977 Animal Ecology 443/542:
Instructor - summer

Research Experience:

- 1971 Conducted a behavioral-ecological study of the Uinta ground squirrel (Spermophilus armatus) in the Bridge National Forest, Wyoming.
- 1973 Laboratory research conducted at the Boulder Veterinary Hospital, Boulder, Colorado. The purpose of this research was to determine methods of administration and post surgical effects of various inhalant anesthetics in snakes.
- 1974 Compiled ecological and distributional field data, collected specimens of reptiles and amphibians (live and preserved), and photographed (35 mm stills, 16 mm movies) reptilian, avian, and mammalian fauna and habitat in the Llanos, Andean and tropical rain forest ecosystems of Venezuela.
- 1975 Conducted an intensive ecological analysis of a tropical lizard community in a tropical dry deciduous forest of Venezuela. Data were collected on the feeding and foraging strategies, reproductive biology and thermoregulatory behavior of the lizards within the community.

Honors:

Guest Lecturer: Subject - Herpetology and Tropical Ecology

- 1973 Boulder Sierra Club
1974 Boulder Audubon Society
1975 Long's Peak Veterinary Society
1974-1976 Boulder Public School System
1976 Continuing Education Program for staff of Denver Museum of Natural History and Denver Zoo
1976 Veterinary Technicians' Association
1976 The Association of the Denver Museum of Natural History (four different occasions)
1976 Summer workshop at Denver Museum of Natural History

Awards:

- Kathy Lichty Fund, University of Colorado, Boulder, Colorado - for research
- Van Riper Fund, University of Colorado Museum, Boulder, Colorado - for research
- The Association of Denver Museum of Natural History - for learning
- demonstration center

Societies

American Association for the Advancement of Science
National Audubon Society
New York Zoological Society
The Society for the Study of Amphibians and Reptiles
Herpetologists' League
Colorado-Wyoming Academy of Science
Colorado Herpetological Society

Publications:

- 1974 Swain, T. Some safety measures in keeping venomous reptiles. Colo. Herpetol. 1(1):10-12.
- 1975 Swain, T. Beef production and wildlife management. La de fensa de la Naturaleza, Caracas, Venezuela.
- 1976 Swain, T. Temperature and activity relationships in Tropidurus torquatus (Sauria: Iguanidae). J. Colo.-Wyo. Acad. Sci.
- 1976 Swain, T. and R. Younkin. Food habitats of a neotropical lizard, Cnemidophorus lemniscatus (Sauria: Teiidae). J. Colo.-Wyo. Acad. Sci.
- 1976 Smith, H.M., R.L. Martin and T. Swain. A South American gecko genus intermediate between two subfamilies. J. Colo.-Wyo. Acad. Sci.
- 1976 Smith, H.M., R.L. Martin and T. Swain. A new genus and two new species of South American geckos (Reptilia: Lacertilia). Papeis Avulsos Zool., Sao Paulo.
- 1977 Swain, T. and H.M. Smith. A communal nest site for Coluber constrictor. Herpetologica (in press).

References:

- Dr. Hobart M. Smith, EPO Biology, University of Colorado
Dr. T. Paul Maslin, University of Colorado Museum
Dr. Alexander Cruz, EPO Biology, University of Colorado